



AAR-100

Human Factors Newsletter # 02-15

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Research Report: *Human Factors Considerations for the Design and Evaluation of Electronic Flight Bags* (Divya C. Chandra, USDOT Volpe Center, Cambridge, Massachusetts; Susan J. Mangold, Battelle Memorial Institute, Columbus, Ohio)

- **Overview**

There is currently great interest in developing stand-alone electronic devices to support flight deck tasks. These devices, called "Electronic Flight Bags," (EFBs) were originally seen as a repository for electronic documents. Today, some airlines envision EFBs as multi-function devices supporting an array of applications, while others envision a simple low-end device used only for viewing documents, or perhaps for performing flight performance calculations. The FAA is charged with approval of EFBs for installation and use in aircraft.

The approval process will be a multi-dimensional effort requiring an understanding of how the device functions and is used by crews, how the device interacts with other cockpit equipment, and training and operating procedures. Volpe Center has been tasked with writing a document on the human factors issues related to EFBs. The goal is for the document to be of value to both system evaluators in the FAA and system designers in industry. The challenge is to create a document that addresses the wide range of proposed EFB implementations, suits the needs of the various readers, and provides useful information for designers and evaluators.

- **Summary and Conclusions**

The core concept of an Electronic Flight Bag is simple and attractive: a pilot's personal flight-deck computer. Airlines are eager to have customized EFBs on board, and manufacturers are eager to develop and supply them. Software providers are eager to customize software for EFBs as well. There are multiple concepts for what an EFB is, ranging from low-end to high-end devices. It is likely that there will be a market for many of these concepts.

The FAA is in the process of responding to industry requests for guidance on the approval of EFBs. Volpe Center is developing a guidance document on the human factors issues related

to use of EFBs. This document will be used by both system evaluators in the FAA and system designers in industry.

Version 1 of the EFB human factors document addresses system considerations, electronic documents, electronic checklists, and flight performance calculations. The next version of the document will address more advanced EFB functions while retaining the structure of Version 1.

The EFB human factors document was structured to meet multiple challenges. It is modular and can easily be extended to address more complex EFB functionality. Guidance topics are carefully written to provide useful information to designers and evaluators. Guidance statements are labeled for quick scanning by different readers. The structure can easily accommodate a large range of EFB-related issues in a format that will stay easy to use, even as the document grows.

A technical report is available on-line at: <http://www.volpe.dot.gov/opsad/chandrdc.html>
(T. McCloy, AAR-100)

Human Factors Research Grant Award (August 2002) – University of Illinois

- **Project Summary**

Cockpit Displays of Traffic Information (CDTI) is an essential element for advanced concepts of Free Flight Phase 2 (FFP2) and beyond, but it is an equally useful element in the short-term visions of FF that involve collaborative decision-making between ground and air. The role of CDTI is likely to be very different from that of the Traffic Alert and Collision Avoidance System (TCAS). While TCAS can be viewed as a “last line of defense” against midair collisions and, as such, a “pure” alerting system, CDTI is going to be a planning tool to evaluate conflict-free trajectories in the FF environment. These differences are very significant from a human factors point-of-view, and they might require very different certification approaches as well.

The objective of this one-year grant is to develop a framework for human factors certification of CDTIs, based on what is known about other alerting algorithms and human performance issues with alerting systems, including trust, situation awareness and workload. The primary focus of this project will be on development and validation of objective certification criteria. Where these are not possible, subjective means may be recommended, provided their reliability and validity can be established.

The project will be divided into four major parts, directed by a number of premises and research hypotheses.

- First, a comprehensive literature review will include empirical human factors results relevant to alerting systems, certification standards, requirements and guidelines related to false alerts and alerting criteria, comparison of the different alerting algorithms and

examination of their congruence with pilots' and controllers' tasks and mental models, ASRS analyses on alerting systems, and literature on human factors certification.

- Second, the findings of the literature review will be synthesized into a framework for human factors certification of Collision Avoidance Systems in general, and certification of CDTI in particular. This framework will include examination of the roles of a number of automatic alerting systems and the impact of these on the respective certification criteria, evaluation of available measures of machine, human, and human-machine system performance as they pertain to collision avoidance systems, identification of primary and secondary measures, and evaluation of empirical support for the latter. Researchers will also examine possible sources and justification of criteria for the measures.
- Third, a laboratory experiment will be conducted to develop a cognitive model of the features of unaided conflict prediction. This model will reveal pilot vulnerabilities that are in greatest need of automation support and suggest design solutions to provide such support as well as identifying pilot vulnerabilities to unreliable predictions.
- Finally, a detailed plan will be developed to continue the research based on the findings and results of the first year effort, focusing on empirical research. Researchers will develop experimental designs and protocols to investigate the questions that have not been sufficiently answered by previous research and that are most relevant to human factors certification of CDTIs. They will also identify data sources for evaluation of CDTI and human performance in operational settings.

The ultimate goal of the research will be to provide the FAA with sufficient knowledge and tools to make informed certification decisions regarding collision avoidance systems and to develop procedures for their safe and efficient use. Deliverables will coincide with the four parts of the project described above and include (1) a comprehensive technical report on the results of the literature review, (2) a framework for human factors certification of CDTIs, (3) results of the experiment and an interpretation in terms of CDTI certification, and (4) a detailed plan for further research. (W. Krebs, AAR-100)

ATC Displays: Human factors researchers from the William J. Hughes Technical Center (ACB-220) visited the Cleveland Air Route Traffic Control Center to evaluate two large screen display systems. One was the projector display system currently used for the Enhanced Status Information System (ESIS) and the other was a plasma display. The purpose of the evaluation was to investigate and document any usability or maintenance issues. The results of the evaluation will be considered when a replacement for the existing system is selected. (T. Yuditsky, WJHTC)

ADS-B: A CAMI researcher traveled to Anchorage, Alaska to make a presentation at the International Advanced Avionics Technology Conference, held at the University of Alaska, Anchorage Aviation Research Center. The title of the presentation was, "Assessment of Advanced Cockpit Displays for GA Aircraft - The Capstone Program." The presentation summarized a data collection effort conducted in Bethel, Alaska regarding the use of advanced

cockpit displays by pilots in the Bethel area. The conference was attended by several national and international groups currently working with Automatic Dependent Surveillance - Broadcast (ADS-B) technologies, including representatives from Australia, Japan, Russia, Mongolia, and Europe. (K. Williams, CAMI)

APA Convention: Representatives from CAMI/AAM-500 participated in the American Psychological Association's (APA) 110th Annual Convention in Chicago, IL August 22-25, 2002. The following were CAMI co-chairs and participants:

- APA Symposium: *Stress, Fatigue, and Performance of Shiftworkers in a Dynamic Safety-Critical Occupation*. Co-chairs: David Schroeder, Ph.D. and Thomas E. Nesthus, Ph.D.
- Participants:

Air Traffic Controllers' Self-Reported Occupational Stress, Anxiety, and Well-Being. D.J. Schroeder, T.E. Nesthus, C. Cruz

Sleep Duration, Subjective Fatigue, and Mood Reported During Four Different Workshift Schedules. T.E. Nesthus, C. Cruz, A. Boquet, L. Dobbins, and K. Holcomb

Vigilance and Complex Task Performance in Clockwise and Counter-Clockwise Rapidly Rotating Shift Schedules. C. Cruz, A. Boquet, C. Detwiler, and T.E. Nesthus

Neuroendocrine and Circadian Rhythm Changes Associated with Clockwise and Counter-Clockwise Rapidly Rotating Shift Schedule. A. Boquet, C. Cruz, C. Detwiler, and T.E. Nesthus

Hypothalamic-Pituitary-Adrenocortical Activity Is Related to Decrements in Performance on a Vigilance Task. C. Detwiler, A. Boquet, C. Cruz, and T.E. Nesthus

For additional information, contact Dr. Tom Nesthus/CAMI.

Flight Information System Data Content Checklist: A CAMI scientist was in Phoenix, AZ on August 19, 2002 to apply a preliminary version of an information-content checklist to a Flight-Information System simulation (TRACS) at Honeywell. The simulation was "flown" through a number of flight phases and information content and accessibility were compared with data on the checklist. A number of desirable modifications and revisions were identified, and an additional meeting was scheduled for September 18, 2002 to further refine the instrument. The checklist will also be applied to a Jeppesen navigation product and compared with data obtained in a usability assessment. (D. Beringer, CAMI)

Multi-Function Displays: CAMI representatives met with personnel from Monterey Technologies, Inc. and with certification personnel at the Wichita ACO on August 21-22, 2002 to collect validation data on the use of a modified human factors pocket guide for the certification of multi-function displays. Two systems were used in the evaluations, one from the pretest (KMD-150) and another (Jeppesen) as a second reference point so that comments from

ACO personnel using the guide could be compared with usability data obtained earlier. (D. Beringer, CAMI)

More information on human factors research can be found at the FAA Human Factors (AAR-100) web site: <http://www.hf.faa.gov>

Mark D. Rodgers
FAA (AAR-100)



September 10-12, 2002 – SAE Aircraft Seat Committee Meeting, Vancouver, Canada
<mailto:elizd@sae.org>

September 11-12, 2002 – SAE A-20 Aircraft Lighting Committee, Kissimmee, FL
<mailto:elizd@sae.org>

September 16-18, 2002 – Conference on Aerospace Materials, Processes and Environmental Technology, Huntsville, AL <http://ampet.msfc.nasa.gov/>

September 17-20, 2002 – International Air Cargo Forum, Hong Kong <http://www.tiaca.org/>

September 29- October 4, 2002 – Human Factors and Ergonomics Society 46th Annual Meeting, Baltimore Waterfront Marriott Hotel, Baltimore, MD <http://www.hfes.org/>

September 30 – October 1, 2002- FAA R,E&D Advisory Committee (REDAC) Meeting, Holiday Inn Westpark, Rosslyn, VA http://research.faa.gov/aar/redac_meetings.asp

October 1-3, 2002 – SAE S-7 Flight Deck and Handling Quality Standards for Transport Aircraft, Prague, Czech Republic <mailto:elizd@sae.org>

October 7-11, 2002 – SAE S-18 Airplane Safety Assessment Committee, Reno, NV
<mailto:lemon@sae.org>

October 8-9, 2002 – SAE S-9 Cabin Safety Provisions Committee, Reno, NV
<mailto:elizd@sae.org>

October 9-10, 2002 – SAE AE-8B1 Protective Devices Committee, Tampa, FL
<mailto:elizd@sae.org>

October 10-19, 2002 – The World Space Conference, Houston, TX www.aiaa.org/wsc2002

October 14-16, 2002 – Third LOSA Week, Dubai, United Arab Emirates
<mailto:dmaurino@icao.int>

October 14-16, 2002 – SAE A-10 Aircraft Oxygen Committee, Dayton, OH
<mailto:elizd@sae.org>

October 21-24, 2002 – 2nd Annual FAA Centers of Excellence Meeting, Wichita, KS
<http://www.niar.twsu.edu/faacoe>

October 23-25, 2002 – International Conference on Human-Computer Interaction in Aeronautics, Massachusetts Institute of Technology, Cambridge, MA <http://www-eurisco.onecert.fr/events/hci-aero2002.html/>

October 23-25, 2002 – SAE AC-9 Aircraft Environmental Systems Committee, Albuquerque, NM
<mailto:elizd@sae.org>

October 27-31, 2002 – 21st Digital Avionics Systems Conference, Hyatt Regency Hotel, Irvine, CA <http://www.dasconline.org/>

November 5-7, 2002 – SAE World Aviation Congress and Display, Sheraton Crescent Hotel, Phoenix, AZ <http://www/sae.org/calendar/aeromtg.htm>

November 21-24, 2002 – 43rd Annual Meeting of the Psychonomic Society, Hyatt and Westin Hotels, Kansas City, MO <mailto:psp@psychonomic.org>

December 10-14, 2002 – Neural Information Processing Systems 2002, Vancouver, Canada
<http://www.nips.cc/>

January 13-17, 2003 – SAE S-18 Airplane Safety Assessment Committee, Salt Lake City, UT
<mailto:lemon@sae.org>

January 14-16, 2003 – SAE Aircraft Seat Committee, San Diego, CA <mailto:elizd@sae.org>

January 27-31, 2003 – SAE G-10 Aerospace Behavioral Engineering Technology Committee, Melbourne, FL <mailto:lemon@sae.org>

February 4-6, 2003 – SAE North American Aviation Safety Conference, Atlanta, GA
<http://www/sae.org/calendar/aeromtg.htm>

March 3-6, 2003 – SAE 2003 World Congress, Cobo Center, Detroit, MI
<http://www/sae.org/congress/index.htm>

March 24-28, 2003 – SAE Airplane Safety Assessment Committee, Lisbon, Portugal
<mailto:lemon@sae.org>

April 2-8, 2003 – Sun ‘n Fun EAA Fly In, Lakeland, FL <http://www.sun-n-fun.org>

April 5-10, 2003 –CHI 2003 Conference on Human Factors in Computing Systems, Broward Convention Center, Ft. Lauderdale, FL <http://www.chi2003.org/>

April 7-27, 2003 – Aviation World’s Fair, Newport News/Williamsburg, VA
<http://www.worlds-fair.com/> or <http://aviation-worlds-fair.com/>

April 9-11, 2003 – *SAE Aircraft Environmental Systems Committee, Dayton, OH*
<mailto:elizd@sae.org>

April 27-30, 2003 – Symposium on Interactive 3D Graphics, Monterey Marriott, Monterey, CA
<mailto:Pausch@cmu.edu>

May 3-10, 2003 – International Conference on Software Engineering, Hilton Portland, Portland, OR <mailto:ldillon@cse.msu.edu>

May 4-9, 2003 – 74th Annual Scientific Meeting of the Aerospace Medical Association, Convention Center, San Antonio, TX <http://www.asma.org/>

May 12-17, 2003 - 2003 IEEE International Conference on Robotics and Automation, The Grand Hotel, Taipei, Taiwan <http://www.icra2003.org/>

June, 2003 – *SAE Digital Human Modeling for Design and Engineering, Location TDB*
<http://www/sae.org/calendar/aeromtgs.htm>

June 15-22, 2003 – 45th Paris Air Show le bourget <http://www.paris-air-show.com/index3.htm>

June 22-27, 2003 – 10th International Conference on Human-Computer Interaction, Institute of Computer Science Foundation, Research and Technology, Science and Technology Park of Crete, Heraklion, Crete, Greece <mailto:info@hcii2003.gr>

June 24-26, 2003 – Human Systems Integration Symposium “Enhancing Human Performance in Naval and Joint Environments”, Sheraton Premier Hotel, Tyson’s Corner, VA
<http://www.navalengineers.org/>

July 7-10, 2003 – *SAE 33rd International Conference on Environmental Systems, The Westin Bayshore Resort and Marina, Vancouver, Canada* <http://www/sae.org/calendar/aeromtgs.htm>

July 14-17, 2003 – AIAA/ICAS International Air & Space Symposium and Exposition, Dayton Convention Center, Dayton, OH <http://www.flight100.org/>

July 29-August 4, 2003 – 51st Annual AirVenture, Oshkosh, WI <http://airventure.org/>

August 7-10, 2003 – 111th Convention of the American Psychological Association, Toronto, Ontario, Canada <http://www.apa.org/convention>

September 9-11, 2003 – *SAE Aerospace Congress and Exhibition, Palais des Congrès, Montreal, Quebec, Canada* <http://www/sae.org/calendar/aeromtgs.htm>

October 13-17, 2003 – Human Factors and Ergonomics Society 47th Annual Meeting, Adams Mark Denver Hotel, Denver, CO <http://www.hfes.org/>

April, 2004 – SAE General Aviation Technology Conference and Exhibition, Century II Convention Center, Wichita, KS <http://www/sae.org/calendar/aeromtg.htm>

July 27-August 2, 2004 – 52nd Annual AirVenture, Oshkosh, WI <http://airventure.org/>

May 2-7, 2004 – 75th Annual Scientific Meeting of the Aerospace Medical Association, Egan Convention Center, Anchorage, AK <http://www.asma.org/>

July 28 – August 1, 2004 – 112th Convention of the American Psychological Association. Honolulu, Hawaii <http://www.apa.org/convention>

September 20-24, 2004 – Human Factors and Ergonomics Society 48th Annual Meeting, Sheraton New Orleans Hotel, New Orleans, LA <http://www.hfes.org/>

Note: Calendar events in Italics are new since the last Newsletter



Comments or questions regarding this newsletter?
Please contact Bill Berger at (334) 271-2928
or via e-mail at bill.ctr.berger@faa.gov